National Advisory Committee for Aeronautics

Research Abstracts

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CURRENT NACA REPORTS

NACA Rept. 1133

MECHANISM OF START AND DEVELOPMENT OF AIRCRAFT CRASH FIRES. I. Irving Pinkel, G. Merritt Preston and Gerald J. Pesman. 1953. iii, 52p. diagrs., photos., 2 tabs. (NACA Rept. 1133. Formerly RM E52F06)

Full-scale aircraft crashes were made to investigate the mechanism of the start and development of aircraft crash fires. The results are discussed herein. This investigation revealed the characteristics of the ignition sources, the manner in which the combustibles spread, the mechanism of the union of the combustibles and ignition sources, and the pertinent factors governing the development of a crash fire as observed in this program.

NACA Rept. 1134

PHOTOGRAPHIC INVESTIGATION OF COMBUSTION IN A TWO-DIMENSIONAL TRANSPARENT ROCKET ENGINE. Donald R. Bellman, Jack C. Humphrey and Theodore Male. 1953. ii, 12p. diagrs., photos., tab. (NACA Rept. 1134. Formerly RM E8F01)

Motion pictures at camera speeds up to 3000 frames per second were taken of the combustion of liquid oxygen and gasoline in a 100-pound thrust rocket engine. The effect of seven methods of propellant injection on the uniformity of combustion was investigated. The flame front was generally found to extend to the injector faces and all the injection systems showed considerable nonuniformity of combustion. Pressure vibration records indicated combustion vibrations that corresponded to resonant-chamber frequencies.

NACA Rept. 1151

THE EFFECTS ON DYNAMIC LATERAL STABILITY AND CONTROL OF LARGE ARTIFICIAL VARIATIONS IN THE ROTARY STABILITY DERIVATIVES. Robert O. Schade and James L. Hassell, Jr. 1953. ii, 24p. diagrs., photo., 2 tabs. (NACA Rept. 1151. Formerly TN 2781)

The results of an experimental and theoretical investigation of the effects of large artificial variations of four rotary stability derivatives on the dynamic lateral stability and control of a 45° sweptback-wing airplane model are presented. The experimental results are presented mainly in the form of flight ratings for stability, control, and general flight behavior. Calculations of period and damping and of the response to rolling and yawing disturbances are also presented.

NACA Rept. 1163

A VISUALIZATION STUDY OF SECONDARY FLOWS IN CASCADES. Howard Z. Herzig, Arthur G. Hansen and George R. Costello. 1954. ii, 51p. diagrs., photos. (NACA Rept. 1163. Formerly TN 2947; RM E52F19)

Flow-visualization techniques are employed to ascertain the streamline patterns of the nonpotential, secondary flows in the boundary layers of cascades, thereby providing a basis for more extended analyses in turbomachines. The three-dimensional deflection of the end-wall boundary layer results in the formation of a vortex well up in each cascade passage. The size and tightness of the vortex generated depend upon the main flow turning in the cascade passage. Once formed, a vortex resists turning in subsequent blade rows. This results in unfavorable angles of attack and possible flow disturbances on the pressure surfaces of subsequent blade rows when the vortices impinge on these surfaces. Two major tip-clearance effects are observed: the formation of a tip-clearance vortex, and the scraping effect of a blade with relative motion past the wall boundary layer. The flow patterns indicate methods for improving the blade-tip loading characteristics of compressors and of low- and high-speed turbines.

NACA Rept. 1164

CONVECTION OF A PATTERN OF VORTICITY THROUGH A SHOCK WAVE. H. S. Ribner. 1954. ii, 17p. diagrs. (NACA Rept. 1164. Formerly TN 2864)

An arbitrary weak spatial distribution of vorticity can be represented in terms of plane sinusoidal shear waves of all orientations and wave lengths (Fourier integral). The analysis treats the passage of a single representative weak shear wave through a plane shock and shows refraction and modification of the shear wave with simultaneous generation of an acoustically intense sound wave. Applications to turbulence and to noise in supersonic wind tunnels are indicated.

NACA Rept. 1171

EFFECT OF HORIZONTAL-TAIL SPAN AND VERTICAL LOCATION ON THE AERODYNAMIC CHARACTERISTICS OF AN UNSWEPT TAIL ASSEMBLY IN SIDESLIP. Donald R. Riley. 1954. ii, 20p. diagrs., photos., tab. (NACA Rept. 1171. Formerly TN 2907)

Wind-tunnel results on the effect of hoirzontal-tail span and vertical location of the horizontal tail relative to the vertical tail on the aerodynamic

characteristics of an unswept vertical-tail assembly in sideslip are presented. By applying the well-known discrete-horseshoe-vortex method used for wings to the problem of intersecting surfaces, theoretical span loadings were obtained for each of the configurations tested. Calculated values obtained from the span loadings are compared with experimental results.

NACA Rept. 1172

A STUDY OF THE APPLICATION OF POWER-SPECTRAL METHODS OF GENERALIZED HARMONIC ANALYSIS TO GUST LOADS ON AIRPLANES. Harry Press and Bernard Mazelsky. 1954. ii, 17p. diagrs., 2 tabs. (NACA Rept. 1172. Formerly TN 2853)

The applicability of some results from the theory of generalized harmonic analysis to the analysis of gust loads on airplanes in continuous rough air is examined. The input and output relations in terms of power spectrums are used to relate the standard deviation (root mean square) of loads in continuous rough air to the gust response characteristics of the airplane and the spectral characteristics of atmospheric turbulence. For the case of a normally distributed output, which appears from experimental evidence to apply to a homogeneous turbulence condition, the probability distribution of loads is shown to be a simple function of the output power spectrum. In order to illustrate the application of power-spectral analysis to gust loads and to obtain an insight into the relation between loads in continuous rough air and the gust response characteristics of the airplane, two selected series of calculations are presented. The results of these applications are compared with those obtained from calculations for single gusts and their implications are discussed.

NACA TM 1366

HEAT TRANSFER BY FREE CONVECTION FROM HORIZONTAL CYLINDERS IN DIATOMIC GASES. (Warmeübergang bei breier Strömung am wagrechten Zylinder in zweiatomigen Gasen). R. Hermann. November 1954. 73p. diagrs., photos., 6 tabs. (NACA TM 1366. Trans. from VDI Forschungsheft, No.379, 1936)

Heat transfer by free convection from horizontal cylinders in diatomic gases is investigated theoretically and experimentally. The heat transfer is given by the theoretical equation $Nu = 0.37(Gr)^{1/4}$ for $10^4 < Gr < 3 \times 10^8$. Experimental determinations of velocity, temperature, and heat transfer are in good agreement with the theory. It is found that the total heat transfer and the boundary-layer development at the upper stagnation point and at the upper edge, respectively, of a horizontal cylinder are equivalent to the respective quantities for a vertical plate which transfers heat on both sides and is 1.31 times the cylinder diameter. A review and discussion of previous investigations of free-convection heat transfer from horizontal cylinders is included.

NACA TM 1373

ON FORCE-DEFLECTION DIAGRAMS OF AIRPLANE SHOCK ABSORBER STRUTS. FIRST, SECOND, AND THIRD PARTIAL REPORTS. (Zur Kenntnis der Kraftwegdiagramme von Flugzeugfederbeinen). K. Schlaefke. November 1954. 48p. diagrs., 4 tabs. (NACA TM 1373. Trans. from Technische Berichte, v. 11, nos. 2, 4, & 5, 1944)

This paper, which is presented in three parts, is an analytical study of the behavior of landing-gear shock struts, with various types of assumptions for the shock-strut characteristics. The effects of tire springing are neglected. The first part compares the behavior of struts with linear and quadratic damping. The second part considers struts with nonlinear spring characteristics and linear or quadratic damping. The third part treats the oleo-pneumatic strut with air-compression springing without damping and with damping proportional to velocity. It is indicated how the damping factor can be determined by experiment.

NACA TM 1378

DETERMINATION OF THE ELASTIC CONSTANTS OF AIRPLANE TIRES. (Ermittlung der elastischen Konstanten von Flugzeugreifen). Boeckh. November 1954. 39p. diagrs. (NACA TM 1378. Trans. from Focke-Wulf Flugzeugbau G.m.b.H, Bremen, V.13.3703)

Measurements were made of the distortion of four German aircraft tires, from about 22 to 28 inches in diameter, at several vertical loadings. For each vertical loading measurements were made of the tire distortion under several lateral, tangential and torsional loadings.

NACA TM 1381

ON THE DETERMINATION OF CERTAIN BASIC TYPES OF SUPERSONIC FLOW FIELDS. (Sulla determinazione di alcuni tipi di campi di corrente ipersonora). Carlo Ferrari. November 1954. 17p. diagrs. (NACA TM 1381. Trans. from Rendiconti della R. Accademie Nazionale dei Lincei, Series 8, v. 7, no. 6, Dec. 1949)

A discussion is given of the application of Fourier series techniques to the problems of linearized supersonic flow. The formulation presented is an extension of the doublet type of "fundamental solution" to higher order types of singularity. The equations developed have application to wing theory but are primarily of importance in wing-body interaction problems. A specific example of a wing-body interference problem is discussed in light of the presented methods.

NACA TN 3217

THE INFLUENCE OF WHEEL SPIN-UP ON LANDING-GEAR IMPACT. W. Flügge and C. W. Coale, Stanford University. October 1954. ii, 107p. diagrs., 8 tabs. (NACA TN 3217. Continuation of TN 2743)

This report deals with the influence of wheel drag on landing-gear performance. The differential equations are developed and solved by numerical integration and by an analytical method. Emphasis is placed on dropping influences of minor importance to simplify the computations. Consideration is also given to the influence of offset wheels, inclined shock struts, and friction due to ovalization of the shock-strut cylinder under bending loads.

NACA TN 3219

VISCOSITY CORRECTIONS TO CONE PROBES IN RAREFIED SUPERSONIC FLOW AT A NOMINAL MACH NUMBER OF 4. L. Talbot, University of California. November 1954. 39p. diagrs., photo., 4 tabs. (NACA TN 3219)

Viscosity correction data were obtained for a set of geometrically similar cone probes in supersonic rarefied air flow at a nominal Mach number of 4. Additional experiments were made to determine cone surface pressure distributions and the effects of variable orifice size on the measurement of cone surface pressure. Pressure distributions near the vertex were compared with the tangent-cone and linearized theories.

NACA TN 3242

PRELIMINARY RESULTS FROM FLOW-FIELD MEASUREMENTS AROUND SINGLE AND TANDEM ROTORS IN THE LANGLEY FULL-SCALE TUNNEL. Harry H. Heyson. November 1954. 19p. diagrs., photos. (NACA TN 3242)

Measurements of the flow angles and velocities near lifting helicopter rotors, both single and tandem, at a tip-speed ratio of 0.15 are presented and compared with those of theory. The comparison indicates that the theory is sufficiently accurate for use in preliminary design calculations. The flow behind a rotor is shown to be very much like the flow behind a wing.

NACA TN 3252

DESCRIPTION AND PRELIMINARY FLIGHT INVESTIGATION OF AN INSTRUMENT FOR DETECTING SUBNORMAL ACCELERATION DURING TAKE-OFF. Garland J. Morris and Lindsay J. Lina. Noven.ber 1954. 19p. diagrs., photos. (NACA TN 3252)

An instrument actuated by longitudinal acceleration and impact pressure has been proposed which would give a quick and easily recognizable quantitative indication of loss in airplane acceleration during take-off. A preliminary evaluation from flight tests of a simplified prototype instrument mounted in a jet trainer has been made. The instrument was found to be satisfactory and the response of the indicator to simulated partial power loss was rapid.

NACA TN 3260

SMOKE STUDY OF NOZZLE SECONDARY FLOWS IN A LOW-SPEED TURBINE. Milton G. Kofskey and Hubert W. Allen. November 1954. 24p. diagrs., photos. (NACA TN 3260)

Still and motion pictures were made of boundary-layer and wake secondary-flow phenomena visualized by smoke. Two annular cascades of turbine nozzles were used, both designed for constant discharge angle but differing in blade shape and suction-surface velocity distribution. Flows were similar to those obtained with pressure and angle measurements at near-sonic airspeeds. Boundary-layer cross-channel and trailing-edge radial flows caused vortices and an accumulation of low-momentum air at the hub, which may affect flow in following blade rows. Motion of a downstream rotor blade row produced pulsations in trailing-edge radial flow. The motion-picture supplement may be obtained on loan from NACA Headquarters, Washington, D. C.

NACA TN 3268

SHEARING-STRESS MEASUREMENTS BY USE OF A HEATED ELEMENT. H. W. Liepmann and G. T. Skinner, California Institute of Technology. November 1954. 27p. diagrs. (NACA TN 3268)

The present report discusses the use of an instrument to determine the local skin-friction coefficient by measurement of heat transfer from small elements embedded in the surface. The range of application of such instruments is discussed and experimental data are presented to show that a simple instrument consisting of an ordinary hot-wire cemented into a groove in the surface can be used to obtain laminar and turbulent skin-friction coefficients with a single calibration.

NACA TN 3283

AERODYNAMIC FORCES, MOMENTS, AND STABILITY DERIVATIVES FOR SLENDER BODIES OF GENERAL CROSS SECTION. Alvin H. Sacks. November 1954.(i), 74p. diagrs., 2 tabs. (NACA TN 3283)

Formulas are developed for forces and moments in terms of the body shape and motions, and for stability derivatives in terms of the mapping functions of the cross sections. Relationships are found among the various derivatives, and calculations are made for several configurations. The influence of the squared terms in the pressure relation is demonstrated, and the use of the apparent mass concept is discussed in detail.

NACA TN 3286

GENERALIZED INDICIAL FORCES ON DEFORMING RECTANGULAR WINGS IN SUPERSONIC FLIGHT. Harvard Lomax, Franklyn B. Fuller and Loma Sluder. November 1954.74p. diagrs., tab. (NACA TN 3286)

A method is presented for determining the time-dependent flow over a rectangular wing moving with a supersonic forward speed and undergoing small vertical distortions expressible as polynomials involving spanwise and chordwise distances. Results are expressed in terms of generalized indicial forces. Numerical results for Mach numbers of 1.1 and 1.2 are given for polynomials of the first and fifth degree in the chordwise and spanwise directions, respectively, on a wing of aspect ratio 4.

NACA TN 3291

EXPERIMENTAL INVESTIGATION OF NOTCH-SIZE EFFECTS ON ROTATING-BEAM FATIGUE BEHAVIOR OF 75S-T6 ALUMINUM ALLOY. W. S. Hyler, R. A. Lewis and H. J. Grover, Battelle Memorial Institute. November 1954. 47p. diagrs., photos., 12 tabs. (NACA TN 3291)

This investigation was initiated to study the influence of size, particularly the notch size, on extruded 75S-T6 aluminum-alloy test specimens. Unnotched and notched specimens with five different minimum-section diameters were tested. For each size a semicircular groove was tested and for the largest diameter specimen a V-notch was also tested. A method of surface preparation was selected that would produce comparable surface finishes in different-sized notched and unnotched specimens.

NACA TN 3292

INFLUENCE OF EXPOSED AREA ON STRESS-CORROSION CRACKING OF 24S ALUMINUM ALLOY. William H. Colner and Howard T. Francis, Armour Research Foundation. November 1954. 22p. diagrs., photos., tab. (NACA TN 3292)

Results are presented of a study of the "area effect" in 24S aluminum alloy. This effect is the phenomenon whereby small exposed areas show long times to stress-corrosion failure, whereas large areas show short times. The effects of stress level, degree of sensitivity of the alloy, and hydrogen peroxide concentration in the corrosion medium were studied. Hydrogen peroxide decomposition and the substitution of oxygen for peroxide were also investigated.

NACA TN 3305

SOME MEASUREMENTS AND POWER SPECTRA OF RUNWAY ROUGHNESS. James H. Walls, John C. Houbolt and Harry Press. November 1954. 27p. diagrs., tab. (NACA TN 3305)

Measurements of actual runway roughness obtained by a profile-survey method (engineer's level) are presented. Data were obtained from a survey of a relatively rough runway and a smooth runway. The results of this study are presented as roughness profiles of the runways surveyed and in the form of power spectra.

NACA TN 3308

AN EXPLORATORY INVESTIGATION OF SOME TYPES OF AEROELASTIC INSTABILITY OF OPEN AND CLOSED BODIES OF REVOLUTION MOUNTED ON SLENDER STRUTS. S. A. Clevenson, E. Widmayer, Jr. and Franklin W. Diederich. November 1954. 44p. diagrs., photos., 3 tabs. (NACA TN 3308. Formerly RM L53E07)

The aeroelastic instability of rigid open and closed bodies of revolution mounted on thin, flexible struts has been investigated experimentally at low speeds. Three types of instability were observed - coupled flutter, divergence, and an uncoupled oscillatory instability which consists in continuous or intermittent small-amplitude yawing oscillations. An attempt has been made to calculate the airspeeds and, in the case of the oscillatory phenomena, the frequencies at which these types of instability occur by using slender-body theory for the aerodynamic forces on the bodies.

NACA TN 3310

INVESTIGATION OF STATIC STRENGTH AND CREEP BEHAVIOR OF AN ALUMINUM-ALLOY MULTIWEB BOX BEAM AT ELEVATED TEMPERATURES. Eldon E. Mathauser. November 1954. 21p. diagrs., photos., 4 tabs. (NACA TN 3310)

Results of an investigation to determine static strength and creep behavior at elevated temperatures of 24S-T3 aluminum-alloy multiweb box beams are presented. Methods that were used to predict failure stresses in the static-strength tests were in good agreement with the experimental results. Creep deflections and creep lifetimes are presented for beams subjected to constant load and various heating conditions. Lifetime is satisfactorily predicted from material stress-rupture data when tensile failure occurs at both constant and varying temperatures.

NACA TN 3313

SOME MEASUREMENTS OF ATMOSPHERIC TURBULENCE OBTAINED FROM FLOW-DIRECTION VANES MOUNTED ON AN AIRPLANE. Robert G. Chilton. November 1954. 22p. diagrs., photo., tab. (NACA TN 3313)

The power spectrum of high-frequency turbulence in the atmosphere was calculated from measurements made in flight. The spectrum was found to display an inverse variation with the square of frequency. This variation is in agreement with the high-frequency asymptote of the spectrum form commonly associated with isotropic turbulence. Flow-direction vanes were used to measure vertical and horizontal components of gust velocity relative to the airplane and normal to the flight direction. The power spectral densities of the two components were, for practical purposes, equal.

NACA TN 3315

TENSILE AND COMPRESSIVE STRESS-STRAIN PROPERTIES OF SOME HIGH-STRENGTH SHEET ALLOYS AT ELEVATED TEMPERATURES. Philip J. Hughes, John E. Inge and Stanley B. Prosser. November 1954. 32p. diagrs., photos., 6 tabs. (NACA TN 3315)

Results of tensile and compressive stress-strain tests at temperatures up to 1,200° F are presented for SAE 4340, Hy-Tuf, Stainless W, and Inconel X sheet materials which had ultimate tensile strengths at room temperature in the 170 to 220 ksi range. Representative tensile and compressive stress-strain curves are given for each material at the test temperatures. Secant and tangent moduli, obtained from the compressive data, are included.

NACA TN 3343

SUBSONIC EDGES IN THIN-WING AND SLENDER-BODY THEORY. Milton D. Van Dyke. November 1954. 26p. diagrs. (NACA TN 3343)

A simple technique is presented for correcting the singularities predicted by thin-wing and slender-body theory at subsonic edges. Thus, Lighthill's rule for speeds on round-nosed airfoils in incompressible flow is extended to higher approximations, compressible flow, three-dimensional wings, sharp edges, and slender bodies of revolution.

NACA TN 3345

ARRANGEMENT OF FUSIFORM BODIES TO REDUCE THE WAVE DRAG AT SUPERSONIC SPEEDS. Morris D. Friedman and Doris Cohen. November 1954 23p. diagrs. (NACA TN 3345. Formerly RM A51I20)

Using linearized slender-body theory and reverse-flow theorems, the wave drag of a system of fusiform bodies at zero angle of attack and supersonic speeds is studied to determine the effect of varying the relative location of the component parts. It is found that in certain arrangements the interference effects are beneficial, and may even result in a two- or three-body system having no more wave drag than the principal body alone. The most favorable location appears to be one in which the maximum cross section of the auxiliary body is slightly forward of the Mach cone from the tail of the main body.

BRITISH REPORTS

N-33504*

Forest Products Research Lab. (Gt. Brit.)
TRIALS OF TIMBERS FOR PLYWOOD MANUFACTURE. SEPETIR - PSEUDOSINDORA PALUSTRIS - SARAWAK. (POUNDS PER CUBIC FOOT AT 15 PER CENT MOISTURE CONTENT) PROGRESS REPORT TWENTY-FOUR. August 1954. 17p. (Forest Products Research Lab.)

Thirteen 5-ft 3-in. billets were used for obtaining yield data and two were used for processing trials. Good green veneer was smooth and free from defects except end splits, which were rather numerous and hindered spooling. The extreme straightness of the grain resulted in easy breakage and made high-speed power spooling impossible. Generally the veneer was similar in texture to afara. The heartwood and sapwood had similar drying properties but the sapwood is a greenish color very distinct from the pinkish heartwood. It is classified as being unsuited to British mills but is technically sound for plywood making and might be of value for this purpose in the country of origin.

N-34046*

Royal Aircraft Establishment (Gt. Brit.)
THE EFFECT OF SURFACE FINISH ON THE FATIGUE RESISTANCE OF TWO ALUMINIUM ALLOYS. N. J. F. Gunn. March 1954. 19p. diagrs., 13 tabs. (RAE Tech. Note Met. 196)

Tests have been made on two aluminum alloys D.T.D. 683 and B.S.S. 6L1 to ascertain the effect of four finishes on their fatigue strength. The finishes were: rough machined, fine machined, circumferentially polished, and longitudinally polished. The fatigue:ultimate ratios for both materials were found to be approximately: rough machined - 0.30; fine machined - 0.30; circumferentially polished - 0.32; longitudinally polished - 0.34.

N-34048*

Royal Aircraft Establishment (Gt. Brit.)
A GENERALISATION OF THE NYQUIST STABILITY CRITERION WITH PARTICULAR REFERENCE TO PHASING ERROR. R. H. Merson. May 1954. 9p. diagr. (RAE Tech. Note GW 316)

The effect of phasing error on the stability of a two-dimensional linear servomechanism is considered and it is shown that the system will be stable if the phase margin at the cut-off frequency exceeds the phasing error. The more general case of a number of identical servos with cross coupling is investigated and a generlization of the Nyquist criterion for stability is formulated.

N-34049*

Royal Aircraft Establishment (Gt. Brit.)
THE DETERMINATION OF CALCIUM IN TITANIUM METAL. H. J. Allsopp. May 1954. 9p., 7 tabs. (RAE Tech. Note Met. 198)

In the method described, titanium is removed by volatilization as the tetrachloride and the calcium are estimated volumetrically using disodium-ethylenediaminetetra-acetate. The effect of reagent concentrations and some interfering elements has been studied.

N-34051*

Royal Aircraft Establishment (Gt. Brit.)
DIELECTRIC MEASUREMENTS ON SOME LAMINATING RESINS AND THE EFFECT OF MOISTURE ABSORPTION AND TEMPERATURE. A. A. Fyall and J. H. Sewell. June 1954. 29p. diagrs., 16 tabs. (RAE Tech. Note Chem. 1233)

Values are given for the dielectric constant and loss tangent of several resins having potential application in the fabrication of glass-fiber reinforced radomes. Dielectric properties were measured on dry materials and also on materials subjected, for varying periods of time, to tropical conditioning in a humidity chamber. When the resin composition could be varied, that giving the optimum dielectric performance was ascertained. Where possible, measured values were compared with those obtained theoretically. The merits of the resins are compared and their best values summarized.

N-34053*

Royal Aircraft Establishment (Gt. Brit.)
THE ESTIMATION OF SIZE ON GLASS FABRICS: TWO NEW METHODS. E. Haythornthwaite and R. B. King. June 1954. 15p. diagrs., photo., 3 tabs. (RAE Tech. Note Chem. 1231)

Two new methods for the estimation of the size content of glass fabrics have been examined. One method depends on the gasometric estimation of carbon dioxide formed from the carbon present on a fabric sample. The other is a modified volatile loss method suitable for control purposes and designed to minimize the errors inherent in previous methods. Excellent correlation between the results from the two methods was obtained.

N-34055*

Royal Aircraft Establishment (Gt. Brit.)
A NEW HIGH SPEED PHOTOGRAPHIC TECHNIQUE APPLIED TO THE INVESTIGATION OF BUBBLES BURSTING AT AN AIR-WATER INTERFACE. R. L. Aspden. July 1954. 26p. diagrs., photos., 3 tabs. (RAE Tech. Note Instn. 141)

The Colourflash system, a method of picture separation by frequency discrimination whereby a limited number of large negatives of optimum quality can be secured at a rate which is essentially unlimited, and with equipment containing no moving parts, is described in its application to the problems under consideration. A selection of photographs showing processes in the buildup and disintegration of smoke filled bubbles is included.

N-34056*

Royal Aircraft Establishment (Gt. Brit.)
CALIBRATION AND DESCRIPTION OF THE EXHAUSTER SECTION OF THE HIGH ALTITUDE TEST PLANT. E. Simpson and F. S. Margrie. May 1954. 47p. diagrs., photos. (RAE Tech. Note Aero 2303. Formerly RAE Tech. Memo. Aero 329)

This note gives a brief description of the Ex L. F. A. Exhauster Plant now installed at R. A. E. as a unit of the High Altitude Test Plant. The means used to calibrate the plant are described. Results of calibrations indicate that with different combinations of units, at mass flows varying from 1.5 to 4.5 lb/sec pressures of 0.75 inch Hg to 2 inches Hg absolute could be obtained, and at mass flows varying from 3 lb/sec to 8.5 lb/sec pressures of 1.35 inches Hg to 3.3 inches Hg were obtainable. Approximate relative efficiencies are given and lines of possible improvement indicated. A detailed description of the plant and the modifications introduced as a result of operational experience is given. This note is the first of a series describing and giving calibrations of various sections of the High Altitude Plant.

N-34057*

Aeronautical Research Council (Gt. Brit.)
A SIMPLE APPROACH TO THE THEORY OF SECONDARY FLOWS. J. H. Preston. December 10, 1953. 19p. diagrs. (ARC 16,394; FM 1996; EA 320)

A simple method is developed for computing the secondary trailing vorticity which arises when a nonuniform stream is turned. The essential results derived by Squire and Winter and by Hawthorne are obtained with a minimum of analysis and the reason for the secondary trailing vorticity is physically evident. It is shown that for a sudden deflection of a nonuniform stream, no trailing vorticity is set up in the exit flow and hence there is no secondary motion. It is also shown that for small angles of deflection there is no net circulation downstream of a cascade of finite dimensions and it is inferred that this should be true also for large deflections.

N-34106*

Royal Aircraft Establishment (Gt. Brit.)
A CROSSED-FIELDS MULTIPLIER. J. A. Roberts and D. C. Pressey. April 1954. 88p. diagrs., photos., tab. (RAE Tech. Note Arm. 516)

Fed-back d-c amplifiers controlling crossed electric and magnetic fields in a simple bucket cathode-ray tube, VCRX. 340, enable a natural product law to be used in this high-speed, four-quadrant multiplier for analogue computers. The development, design, and theoretical and measured performance are described. Direct measurement shows the static errors to be less than 1 percent of full output, while the change of scale-factor with frequency does not reach 1 percent until 10 kc/s. The power consumption is only 50 w total. The zero drift is small and the long-term stability excellent.

N-34111*

Aeronautical Research Council (Gt. Brit.)
ON THE TURBULENT BOUNDARY LAYER ON A FLAT PLATE OF FINITE WIDTH. A. A. Townsend. March 3, 1954. 10p. diagrs. (ARC 16,618; FM 2042)

A theory is developed for edge effect on the turbulent boundary layer on a flat plate of finite width by considering the equations of motion for the flow.

N-34113*

Aeronautical Research Council (Gt. Brit.) AN EXPERIMENTAL INVESTIGATION OF THE INTERACTION OF A SHOCK WAVE WITH A SUBSONIC STREAM BOUNDED BY A WALL. D. W. Holder, A. Chinneck and G. E. Gadd. February 11, 1954. 17p. diagrs., photos., tab. (ARC 16,559; FM 2025)

A study has been made of a model of a boundary layer consisting of a subsonic stream bounded on one side by a wall and on the other by a supersonic main stream. The subsonic stream was approximately uniform at the point where it first met the main stream, but it became progressively less uniform downstream of this point because of mixing with the main stream and the growth of the boundary layer at the wall. Particular attention is given to the pressure rise which takes place at the wall when a wedge is attached to it. The pressure begins to rise ahead of the apex of the wedge, this upstream effect increases as the Mach number of the secondary stream is reduced.

MISCELLANEOUS

NACA Rept. 1133

Errata No. 1 on "MECHANISM OF START AND DEVELOPMENT OF AIRCRAFT CRASH FIRES." I. Irving Pinkel, G. Merritt Preston and Gerard J. Pesman. 1954.

NACA TN 1315

Errata No. 1 on "FREE-FALLS AND PARACHUTE DESCENTS IN THE STANDARD ATMOSPHERE." A. P. Webster. June 1947.

N-22389*

Advisory Group for Aeronautical Research and Development. SOME ASPECTS OF COMBUSTION OF LIQUID FUEL. Charles C. Graves and Melvin Gerstein. (Scheveningen Netherlands Conference, May 3-7, 1954) 26p. diagrs., photo. (AGARD AG16/M10)

In this paper the combustion of liquid sprays is considered in terms of such individual processes as fuel spray spreading and evaporation. In addition, the efficiency of combustion of liquid fuels in turbojet combustors as affected by fuel volatility, spray characteristics, and the burning rate of single drops is treated. The scope of this paper is limited to a discussion of these factors normally associated with diffusion flames.

N-25254*

Advisory Group for Aeronautical Research and Development. A SCHEME OF AUTOMATIC DATA REDUCTION FOR WIND TUNNELS. K. V. Diprose. (London AGARD Conference, September 3-11, 1953) 17p. diagrs., photos. (AGARD AG9/M5)

The need for automatic devices to speedup reduction of data obtained from wind tunnels in the RAE first became urgent during the war. Up to the present little of the analogue computing equipment suggested in the original plan has been constructed. One computer giving tunnel Mach number was constructed in 1948 and has been in operation ever since in the 10- by 7-foot high-speed tunnel. A "breadboard" model of a computer to calculate uncorrected force coefficients has been made. The design of plotting tables as an alternative form of output is well advanced. Their principal use will be in intermittent wind tunnels where time available for a complete run does not permit printing typed answers.

N-30835A*

Advisory Group for Aeronautical Research and Development. A NOTE ON THE USE OF STRAIN GAUGES IN WIND TUNNEL BALANCES. J. R. Anderson. (London AGARD Conference, September 3-11, 1953) 20p. diagrs., photo. (AGARD AG10/M6)

This paper records some of the experience obtained in the use of strain gage balances in the smaller high-speed wind tunnels of Aerodynamics Department, R.A.E. The discussion is therefore a little restricted in scope, being for the most part limited to the use of bonded, resistance type electrical strain gages in force and moment balances intended for use with models ranging from about 0.4 in. to 1.5 in. in diameter. Much of the discussion should prove of interest in the design of larger installations: for example, the comments which are made on the effects of temperature on the strain gages.

N-33567*

Advisory Group for Aeronautical Research and Development. FORMATION ET DEPOT DE CARBONE DANS LES FOYERS DE TURBOMACHINES D'AVIATION. C. Fouré. (Scheveningen Netherlands Conference, May 3-7, 1954) 21p. diagrs., photos. (AGARD AG12/M8)

Operating with accepted fuels, modern reactionary turbines are not seriously troubled by the formation of carbon deposits. The change towards high compression and towards the use of less powerful fuels alter this situation. The role of certain characteristics of fuels have been clarified. A great deal is yet to be learned about additives to reduce deposits, but modifications can be imagined which may reduce the formation of carbon during combustion in order to prevent eventual deposits on the walls.

N-33583*

DESIGN AND OPERATING TECHNIQUES OF VERTICAL SPIN TUNNELS. A. I. Neihouse. (Presented to Wind Tunnel and Model Testing Panel of Advisory Group for Aeronautical Research and Development, Paris, France, November 2-6, 1954) 16p. diagrs., photos., 2 tabs.

Dynamic tests in a spin tunnel, aided by auxiliary tools and techniques including analytical methods, offers a practical method for a better understanding

of the spinning motion and the recovery therefrom. Just how the moments and forces affect the picture, and just what part the stability characteristics of the airplane at large attitude angles play can be determined by proper research effort. That such effort is necessary has been demonstrated in the past and by experiences with current airplanes; that the problem of spin recovery may become more critical is likely. Adequate facilities to do spin research, however, should lead to eventual solution of the existing problem.

N-33609*

TRANSONIC WIND TUNNEL DEVELOPMENT OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS. H. Julian Allen. (Presented to Wind Tunnel and Model Testing Panel of Advisory Group for Aeronautical Research and Development, Paris, France, November 2-6, 1954) 22p. diagrs., photo.

The development of transonic wind tunnels at the Langley and Ames Aeronautical Laboratories of the NACA is discussed. Two types of wind tunnels suitable for transonic wind tunnel operation are described: the fixed geometry slotted-wall type and the variable-geometry ventilated wall (slotted or porous) type.

N-33610*

DEVELOPMENT OF TWO HYPERSONIC TEST FACILITIES AT THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, AMES AERONAUTICAL LABORATORY. H. Julian Allen. (Presented to Wind Tunnel and Model Testing Panel of Advisory Group for Aeronautical Research and Development, Paris, France, November 2-6, 1954) 41p. diagrs., photos., tab.

Two facilities for hypersonic research which have been developed at the Ames Aeronautical Laboratory are discussed. The first facility is a wind tunnel which is of interest because of its ability to operate continuously over a wide range of speeds with a not-too-complex drive system; while the second is a combination wind tunnel and ballistics range which allows operation over an even wider range of speeds up to speeds which are very difficult to attain in a wind tunnel of the more conventional type.

UNPUBLISHED PAPERS

N-25802*

THE ROTATING WING AS A RADIATION PROBLEM. (Der rotierende Tragflügel als Strahlungsproblem). Wilhelm Ernsthausen. September 1954. 40p. diagrs., photos. (Trans. from Zeitschrift für angewandte Mathematik und Mechanik, v. 31, no. 1/2, Jan./Feb., 1951, p. 20-35)

The forces exerted upon a wing rotating in a compressible gas correspond to the reaction of its field of sound. Therefore, they may be determined from the energy capacity of this field. The investigation is based on the idea of starting with the field of sound and penetrating into the connections between flow and wave concepts. It deals with the determination of the flow forces stemming from the energy of the sound field which acts on the wing, with the mass motion describing the lift finding its expression in the field in the immediate neighborhood, and the radiation losses responsible for the drag finding theirs in the field in the distance.

N-33628*

APPLICABILITY OF THE LAW OF SIMILITUDE TO CAVITATION. (Zum Ähnlichkeitsgesetz für Hohlraumbildungen). A. Reinhardt. April 1954. 34p. diagrs., photo. (Trans. from Forschung auf dem Gebiete des Ingenieurwesens, Ed. B, v. 6, p. 1-12, Jan.-Feb., 1935, Forschungsheft 370)

Conclusions, derived from the theory of similitude, regarding caviation in flow engines were compiled, supplemented, and investigated as to their practical applicability. Two deviations from Newton's similitude of flow were recognizable in the test results. A number of tests were performed with a Kaplan turbine in order to check theoretical results.

DECLASSIFIED NACA REPORTS

THE FOLLOWING REPORTS HAVE BEEN DECLASSIFIED FROM CONFIDENTIAL, 10/29/54:

RM 8J05
RM 51D23
RM E6L11
RM E7J01
RM L8A14
RM L50L08
RM L52C31
RM L52J14

NACA RM A7L24

HIGH-SPEED WIND-TUNNEL TESTS OF A 1/78-SCALE MODEL OF THE LOCKHEED YP-80A AIRPLANE. Robert N. Olson and Leslie F. Lawrence. May 28, 1948. 52p. diagrs., photos. (NACA RM A7L24) (Declassified from Confidential, 10/12/54)

This report contains the results of a high-speed wind-tunnel investigation of a 1/78-scale model of the Lockheed YP-80A airplane, including a comparison of the relative aerodynamic characteristics of the 1/78-scale model, a 1/3-scale model, and a full-scale YP-80A airplane. Also included are the longitudinal stability and control characteristics of the 1/78-scale model with 0° and 45° leading-edge sweepback of the horizontal and vertical tail surfaces.

NACA RM L51K29

PROPELLER LIFT AND THRUST DISTRIBUTION FROM WAKE SURVEYS OF STAGNATION CONDITIONS. Robert E. Davidson. January 1952. 19p. diagrs. (NACA RM L51K29) (Declassified from Confidential, 10/12/54)

This paper gives formulas for propeller lift and thrust distribution in terms of wake-survey measurements of stagnation pressure rise through the propeller. Substantiative data are also included.

NACA RM L51L06

PROPELLER INDUCED ANGLES OF ATTACK AND SECTION ANGLES OF ATTACK FOR THE NACA 10-(3)(066)-03, 10-(3)(049)-03, 10-(3)(090)-03, 10-(5)(066)-03, AND 10-(0)(066)-03 PROPELLERS. William B. Igoe and Robert E. Davidson. May 1952. 80p. diagrs., 10 tabs. (NACA RM L51L06) (Declassified from Confidential, 10/12/54)

This paper presents the results of an induced angle-of-attack calculation using a method applicable to a propeller with arbitrary circulation distribution. Tables of induced angles of attack and section angles of attack and curves of wake-survey results are presented for the NACA 10-(3)(066)-03, 10-(3)(049)-03, 10-(3)(090)-03, 10-(5)(066)-03, and 10-(0)(066)-03 propellers. A brief description of the method of calculating propeller induced angles of attack is given.

NACA RM L51L28

THE EFFECT OF BLADE-SECTION CAMBER ON THE STATIC CHARACTERISTICS OF THREE NACA PROPELLERS. John H. Wood and John M. Swihart. April 1952. 40p. diagrs., photos. (NACA RM L51L28) (Declassified from Confidential, 10/12/54)

This paper contains the effect of blade-section camber on the static characteristics of the NACA 10-(0)(066)-03, 10-(3)(066)-03, and 10-(5)(066)-03 propellers (design lift coefficients of 0, 0.3, and 0.5, respectively). Blade angles from 0° to 16° were tested over a tip Mach number range from 0.28 to 1.02. The results indicate that the use of camber in the propeller design offers advantages in propeller performance and increases in stall-flutter speed at zero advance.

NACA RM L52A03

HINGE-MOMENT AND OTHER AERODYNAMIC CHARACTERISTICS AT TRANSONIC SPEEDS OF A QUARTER-SPAN SPOILER ON A TAPERED 45° SWEPTBACK WING OF ASPECT RATIO 3. Joseph E. Fikes. February 1952. 22p. diagrs., photo. (NACA RM L52A03) (Declassified from Confidential, 10/12/54)

Lift, drag, pitching moment, rolling moment, yawing moment, and spoiler hinge moment were obtained at transonic speeds by testing in the high velocity field over a reflection plane on the side wall of the Langley high-speed 7- by 10-foot tunnel on a wing having a quarter-chord sweepback of 45.58°, an aspect ratio of 3, a taper ratio of 0.5, and an NACA 64A010 section employing an inboard quarter-span plug spoiler. The investigation was made over a limited projection and angle-of-attack range from a Mach number of 0.70 to 1.10.

NACA RM L52A09

EFFECT OF CURRENT DESIGN TRENDS ON AIRPLANE SPINS AND RECOVERIES. Anshal I. Neihouse. January 1952. 6p. diagrs. (NACA RM L52A09) (Declassified from Confidential, 10/12/54)

Charts are presented which indicate that, owing to design of airplanes for transonic and supersonic flight, a wide range of mass distribution of the airplane is possible with accompaning effects upon the nature of the spin and upon the requirements for recovery.

NACA RM L52A11

PRELIMINARY INVESTIGATION OF CONTROL CHARACTERISTICS AT TRANSONIC SPEEDS OF A TAPERED 45° SWEPTBACK WING OF ASPECT RATIO 3 HAVING A HORN-BALANCED FULL-SPAN CONTROL. John G. Lowry and Joseph E. Fikes. April 1952. 22p. diagrs., photo. (NACA RM L52A11) (Declassified from Confidential, 10/12/54)

An experimental investigation was made at transonic speeds by testing in the high-velocity field over a sidewall reflection plane to determine hinge-moment and effectiveness characteristics of a horn-balanced control on an aspect-ratio 3, 45° sweptback wing. Lift, rolling moments, and control hinge moments were obtained through a limited angle-of-attack and control-deflection range from Mach numbers 0.70 to 1.10.

NACA RM L52A14

PRELIMINARY INVESTIGATION OF THE DRAG CHARACTERISTICS OF THE NACA RM-10 MISSILE AT MACH NUMBERS OF 1.40 AND 1.59 IN THE LANGLEY 4- BY 4-FOOT SUPERSONIC TUNNEL. Lowell E. Hasel, Archibald R. Sinclair and Clyde V. Hamilton, April 1952. 49p. diagrs., photos, 3 tabs. (NACA RM L52A14) (Declassified from Confidential, 10/12/54)

A 0.287-scale model of the RM-10 has been tested in the Langley 4- by 4-foot supersonic tunnel at Mach numbers of 1.59 and 1.40. Drag data were obtained from a conventional sting-supported model and from a wire-supported model. Base drag, skin-friction drag, forebody pressure drag, fin drag, and fin interference drag are discussed. The data at a Mach number of 1.59 are compared with that from other facilities.

NACA RM L52A17

ERROR IN AIRSPEED MEASUREMENT DUE TO STATIC-PRESSURE FIELD AHEAD OF AN OPEN-NOSE AIR-INLET MODEL AT TRANSONIC SPEEDS. Thomas C. O'Bryan. March 1952. 17p. diagrs., photos. (NACA RM L52A17) (Declassified from Confidential, 10/12/54)

Contains measurements of the static-pressure coefficient at several distances ahead of an open-nose air-inlet body at zero angle of attack, in the transonic speed range, by the NACA wing-flow method. Measurements are presented to show the effect of inlet-velocity ratio on the static pressure ahead of the inlet. Comparison of the experimental variation of the static-pressure coefficient ahead of the inlet is made with incompressible theory. Calculations are presented to show the effect of changing inlet geometry on the static-pressure coefficient ahead of the inlets.

NACA RM L52A22

THE CALCULATION OF CERTAIN STATIC AEROELASTIC PHENOMENA OF WINGS WITH TIP TANKS OR BOOM-MOUNTED LIFTING SURFACES. Franklin W. Diederich and Kenneth A. Foss. August 1952. 55p. diagrs., 2 tabs. (NACA RM L52A22) (Declassified from Confidential, 10/12/54)

A method is presented for calculating static aeroelastic phenomena of wings with concentrated aerodynamic forces at the tip. Some static aeroelastic characteristics of an unswept wing with a tip tank and of a sweptback wing with several boom-mounted lifting surface configurations have been calculated. These calculations indicate that such a lifting surface merits consideration as a device for relieving adverse aeroelastic effects.

NACA RM L52A23

PRELIMINARY INVESTIGATION AT TRANSONIC SPEEDS OF THE EFFECT OF BALANCING TABS ON THE HINGE-MOMENT AND OTHER AERODYNAMIC CHARACTERISTICS OF A FULL-SPAN FLAP ON A TAPERED 45° SWEPTBACK WING OF ASPECT RATIO 3. Vernard E. Lockwood and Joseph E. Fikes. April 1952. 27p. diagrs., photo., (NACA RM L52A23) (Declassified from Confidential, 10/12/54)

An experimental investigation was performed at transonic speeds in the high-velocity-flow field over a reflection plane in the Langley high-speed 7- by 10-foot tunnel to determine the balancing characteristics of an inset, an attached, and a detached tab on an aspect-ratio 3, 45° sweptback wing. Lift, rolling moments, and flap hinge moments were obtained through a range of angles of attack from 0° to 16° and a Mach number range from 0.7 to 1.1. Data are presented as parameters of the flap and tab.

NACA RM L52A25

LOW-SPEED STABILITY CHARACTERISTICS OF A COMPLETE MODEL WITH A WING OF W PLAN FORM. Edward C. Polhamus and Robert E. Becht. April 1952. 27p. diagrs., photo., tab. (NACA RM L52A25) (Declassified from Confidential, 10/12/54)

An investigation was conducted to determine the low-speed static longitudinal and lateral stability characteristics of a complete model equipped with a W wing of aspect ratio 6, taper ratio 0.6, and panel sweep angles of 45°. Included in the investigation are exploratory tests made in an attempt to delay the early separation in the wing-panel junctures by use of fences, vortex generators, and chord extensions.

NACA RM L52B11

INVESTIGATION OF THE HYDRODYNAMIC STABILITY AND RESISTANCE OF TWO STREAMLINE FUSELAGES. Bernard Weinflash and Charles L. Shuford, Jr. April 1952. 32p. diagrs., photos., tab. (NACA RM L52B11) (Declassified from Confidential, 10/12/54)

An investigation of a dynamic model was made to determine the effects of hull form, gross load, and aerodynamic trimming moments on the trim limits, trim, hydrodynamic moment, hydrodynamic resistance, total resistance, and rise of two streamline fuselage configurations modified by chine strips.

NACA RM L52B13

EFFECTS OF SOME PRIMARY VARIABLES OF RECTANGULAR VORTEX GENERATORS ON THE STATIC-PRESSURE RISE THROUGH A SHORT DIFFUSER. E. Floyd Valentine and Raymond B. Carroll. May 1952. 32p. diagrs., photo., tab. (NACA RM L52B13) (Declassified from Confidential, 10/12/54)

An investigation was made of a 2:1 area ratio diffuser of length equal to the inlet diameter with separate variation of several basic parameters for simple nontwisted rectangular vortex generators over a considerable range of inlet-boundary-layer thickness. Optimum values from the standpoint of static pressure rise were determined for angle of attack, spacing, aspect ratio, and span-to-inlet boundary-layer thickness. The static-pressure rise obtainable by conforming to these findings is given over the range of inlet-boundary-layer thickness.

NACA RM L52B15a

AN INVESTIGATION OF LONGITUDINAL CONTROL CHARACTERISTICS OF A WING-TIP CONTROL SURFACE ON A SWEPTBACK WING AT TRANSONIC SPEEDS BY THE NACA WING-FLOW METHOD. James P. Trant, Jr. June 1952. 23p. diagrs., photos., tab. (NACA RM L52B15a) (Declassified from Confidential, 10/12/54)

Longitudinal control effectiveness of a full-chord wing-tip control on a wing having 35° sweepback 12 percent thickness perpendicular to the quarter-chord line, an aspect ratio of 3.01, and a taper ratio of 0.605 was determined by the NACA wing-flow method at Mach numbers from about 0.65 to 1.1. Measurements were made of normal force, pitching moment, hinge moment, and angle of attack for three control deflections. One control deflection was also tested with an end plate attached to the root chord of the control surface.

NACA RM L52B18

THE EFFECTS ON THE AERODYNAMIC CHARACTERISTICS OF VARYING THE WING THICKNESS RATIO OF A TRIANGULAR WING-BODY CONFIGURATION AT TRANSONIC SPEEDS FROM TESTS BY THE NACA WING-FLOW METHOD. Albert W. Hall and James M. McKay. April 1952. 27p. diagrs., photo., 2 tabs. (NACA RM L52B18) (Declassified from Confidential, 10/12/54)

Tests were made by the NACA wing-flow method at Mach numbers from 0.75 to 1.07 to determine the aerodynamic characteristics of three triangular wing-fuselage models which differed only in wing thickness-chord ratio. All three wings had an aspect ratio of 2.31 with 6-, 9-, and 12-percent-thick biconvex sections and the fuselage had a fineness ratio of 12. Measurements were made of normal force, chord force, and pitching moment for various angles of attack. The test Reynolds number was 1.5×10^6.

NACA RM L52B25

EFFECTS OF HORIZONTAL-TAIL POSITION AND ASPECT RATIO ON LOW-SPEED STATIC LONGITUDINAL STABILITY AND CONTROL CHARACTERISTICS OF A 60° TRIANGULAR-WING MODEL HAVING TWIN TRIANGULAR ALL-MOVABLE TAILS. Byron M. Jaquet. May 1952. 45p. diagrs., photos. (NACA RM L52B25) (Declassified from Confidential, 10/12/54)

Presents results of a low-speed investigation made in Langley stability tunnel to determine effects of horizontal tail position and aspect ratio on low-speed static longitudinal stability and control characteristics of a 60° triangular-wing model having twin-triangular-all-movable tails. All the force tests were made at a Mach number of 0.17 and a Reynolds number of 2.06×10^6. Comparison of results for single and twin tails are made.

NACA RM L52B26

FLIGHT MEASUREMENTS OF THE EFFECTS OF SURFACE CONDITION ON THE SUPERSONIC DRAG OF FIN-STABILIZED PARABOLIC BODIES OF REVOLUTION. H. Herbert Jackson. May 1952. 17p. diagrs., photos. (NACA RM L52B26) (Declassified from Confidential, 10/12/54)

Some measurements of the effects of various types of surface roughness on total drag and base drag were obtained on bodies of revolution in free flight. The Mach number and Reynolds number ranges varied from 0.80 to 2.2 and 15×10^6 to 75×10^6, respectively. The experimental drag coefficients of models having wavy surfaces, sand-coated surfaces, and pitted surfaces are compared with the drag coefficients of smooth models of the same configurations.

NACA RM L52C24

SKIN-FRICTION DRAG AND BOUNDARY-LAYER TRANSITION ON A PARABOLIC BODY OF REVOLUTION (NACA RM-10) AT A MACH NUMBER OF 1.6 IN THE LANGLEY 4- BY 4-FOOT SUPERSONIC PRESSURE TUNNEL. K. R. Czarnecki and Jack E. Marte. May 1952. 24p. diagrs., photos. (NACA RM L52C24) (Declassified from Confidential, 10/12/54)

There are presented the results of an investigation at M = 1.6 and over a Reynolds number range from 2×10^6 to 40×10^6 of the skin-friction drag and boundary-layer transition of a body of revolution (NACA RM-10). The results are compared with other available experimental data and with theory.

NACA RM L52C27

AN APPLICATION OF THE ROCKET-PROPELLED-MODEL TECHNIQUE TO THE INVESTIGATION OF LOW-LIFT BUFFETING AND THE RESULTS OF PRELIMINARY TESTS. Homer P. Mason and William N. Gardner. September 1952. 19p. diagrs., photos. (NACA RM L52C27) (Declassified from Confidential, 10/12/54)

An application of the rocket-propelled-model technique for the investigation of low-lift buffeting is presented, together with data obtained from three preliminary tests by this technique. A correlation between low-lift buffeting, wing dropping, and changes of trim normal force is shown.

NACA RM L52D08a

SMALL-SCALE TRANSONIC INVESTIGATION OF THE EFFECTS OF PARTIAL-SPAN LEADING-EDGE CAMBER ON THE AERODYNAMIC CHARACTERISTICS OF A 50° 38' SWEPTBACK WING OF ASPECT RATIO 2.98. William J. Alford, Jr. and Andrew L. Byrnes, Jr. June 1952. 28p. diagrs., photo., tab. (NACA RM L52D08a) (Declassified from Confidential, 10/12/54)

An investigation of two semispan wings having the same plan form was made in the Langley high-speed 7- by 10-foot tunnel over a Mach number range from 0.70 to 1.10 and a mean-test Reynolds number range from 745,000 to 845,000 to determine the effects of partial-span leading-edge camber on the aerodynamic characteristics of a sweptback wing. This paper presents the results of the wing-alone and wing-fuselage configurations with the wing quarter-chord line sweptback 50° 38' taper ratio 0.45, and NACA 64A-series airfoil sections tapered in thickness ratio. Lift, drag, pitching moment, and root-bending moment were obtained for all configurations.

NACA RM L52D15

A PRELIMINARY INVESTIGATION OF THE STATIC AND DYNAMIC LONGITUDINAL STABILITY OF A GRUMBERG HYDROFOIL SYSTEM. Norman S. Land, Derrill B. Chambliss and William W. Petynia. September 1952. 48p. diagrs., photos. (NACA RM L52D15) (Declassified from Confidential, 10/12/54)

A preliminary investigation was made in order to determine the static and dynamic longitudinal stability characteristics and the force characteristics of the Grunberg hydrofoil system, comprising a main lifting hydrofoil and planing-surface stabilizers. The static stability of the system was determined for several locations of the center of gravity. In smooth water the response to a sudden distrubance was observed. The behavior in waves of various lengths was observed at several speeds, moments of inertia, and locations of the center of gravity. The effects of gross load, hydrofoil and stabilizer incidence, speed, and center-of-gravity location on the lift-drag ratio were determined.

NACA RM L52D21

EFFECTS OF PLAN FORM, AIRFOIL SECTION, AND ANGLE OF ATTACK ON THE PRESSURES ALONG THE BASE OF BLUNT-TRAILING-EDGE WINGS AT MACH NUMBERS OF 1.41, 1.62, AND 1.96. Kennith L. Goin. September 1952. 52p. photos., diagrs. (NACA RM L52D21) (Declassified from Confidential, 10/12/54)

Base pressures were measured at angles of attack of 0° to 15° on two groups of untapered wings of aspect ratio 2.7, the first group being unswept and the second group having 45° of sweepback. Each group included airfoil sections with maximum thickness ratios of 3 to 10 percent and with varying amounts of trailing-edge bluntness. Also included in the investigation to indicate additional effects of wing plan form were a 45° delta wing and a rectangular wing of aspect ratio 5. All wings were tested with fixed transition at Reynolds numbers of between 1×10^6 and 2×10^6.

NACA RM L52D23a

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE LIFT AND DRAG CHARACTERISTICS OF A HYDROFOIL AT SUBCRITICAL AND SUPERCRITICAL SPEEDS. Kenneth L. Wadlin, Charles L. Shuford, Jr. and John R. McGehee. July 1952. 53p. diagrs., photo., tab. (NACA RM L52D23a) (Declassified from Confidential, 10/12/54)

A theoretical and experimental investigation was made of the effect of the free-water surface and rigid boundaries on the lift and drag of an aspect-ratio-10 hydrofoil at both subcritical and supercritical speeds. Approximate theoretical solutions for the effect of the free-water surface and rigid boundaries on lift and drag at supercritical speeds were developed. An approximate theoretical solution for the effect of these boundaries on drag at subcritical speeds was also presented. The agreement between theory and experiment at both supercritical and subcritical speeds is satisfactory for engineering calculations of hydrofoil characteristics from aerodynamic data.

NACA RM L52D25

CONTROL CHARACTERISTICS AT TRANSONIC SPEEDS OF A LINKED FLAP AND SPOILER ON A TAPERED 45° SWEPTBACK WING OF ASPECT RATIO 3. Vernard E. Lockwood and Joseph E. Fikes. July 1952. 24p. diagrs., photo. (NACA RM L52D25) (Declassified from Confidential, 10/12/54)

Lift, drag, pitching-moment, rolling-moment, yawing-moment, and hinge-moment characteristics of the model were obtained at transonic speeds by testing in the high-velocity field over a reflection plane on the side wall of the Langley high-speed 7- by 10-foot tunnel. The wing had a quarter-chord line sweepback of 45.58°, an aspect ratio of 3, a taper ratio of 0.5, and was approximately 7.6 percent thick. A quarter-span plug-type spoiler which was linked to rotate with the flap in the same direction was employed as a control-balancing device. The investigation was made over a limited projection and angle-of-attack range from a Mach number of 0.70 to 1.10.

NACA RM L52D30

PRESSURE DISTRIBUTIONS ON BODIES OF REVOLUTION AT SUBSONIC AND TRANSONIC SPEEDS. Richard I. Cole. July 1952. 47p. diagrs., photos., tab. (NACA RM L52D30) (Declassified from Confidential, 10/12/54)

Pressure distributions along the slender body and along prolate spheroids of fineness ratio 3 to 20 are compared at subsonic and transonic speeds with estimates at angles of attack up to 20°. The comparisons showed that the pressure distributions along the bodies can be predicted with fair accuracy.

NACA RM L52E12

SMALL-SCALE TRANSONIC INVESTIGATION OF THE EFFECTS OF FULL-SPAN AND PARTIAL-SPAN LEADING-EDGE FLAPS ON THE AERODYNAMIC CHARACTERISTICS OF A 50° $38'$ SWEPTBACK WING OF ASPECT RATIO 2.98. Kenneth P. Spreemann and William J. Alford, Jr. July 1952. 31p. diagrs., photo. (NACA RM L52E12) (Declassified from Confidential, 10/12/54)

An investigation was made in the Langley high-speed 7- by 10-foot tunnel over a Mach number range of 0.70 to 1.10 to determine the effects of a number of full-span and partial-span leading-edge-flap deflections on the aerodynamic characteristics of a semi-span model with the quarter-chord line sweptback 50° $38'$, aspect ratio 2.98, taper ratio 0.45, and NACA 64A series airfoil sections tapered in thickness ratio. Lift, drag, pitching moment, and bending moment were obtained for all configurations.

NACA RM L52E19

A THEORETICAL INVESTIGATION OF THE EFFECT OF A TARGET SEEKER SENSITIVE TO PITCH ATTITUDE ON THE DYNAMIC STABILITY AND RESPONSE CHARACTERISTICS OF A SUPERSONIC CANARD MISSILE CONFIGURATION. Ordway B. Gates, Jr. and Albert A. Schy. August 1952. 54p. diagrs., photo., tab. (NACA RM L52E19) (Declassified from Confidential, 10/12/54)

A theoretical investigation is presented of the longitudinal dynamic characteristics of an automatically stabilized supersonic canard missile equipped with a target seeker sensitive to pitch attitude. Effects of seeker gain, time delay, and nonlinearities, which include various dead spots in the target seeker, are considered. The results indicate that satisfactory stability and response characteristics may be obtained for the configuration considered subsequent to command or regulatory inputs but a dead spot in the target seeker causes undesirable steady-state errors in pitch attitude.

NACA RM L52F16

LATERAL-CONTROL INVESTIGATION AT TRANSONIC SPEEDS OF RETRACTABLE SPOILER AND PLUG-TYPE SPOILER-SLOT AILERONS ON A TAPERED 60° SWEPTBACK WING OF ASPECT RATIO 2. TRANSONIC-BUMP METHOD. Alexander D. Hammond and James M. Watson. August 1952. 19p. diagrs. (NACA RM L52F16) (Declassified from Confidential, 10/12/54)

Results and discussion of a lateral-control investigation of retractable spoiler and plug-type spoiler-slot ailerons on a wing with 60° sweepback of the quarter-chord line, aspect ratio 2, taper ratio 0.6, and an NACA 65A006 airfoil section are presented. Data were obtained through an angle-of-attack range of -2° to 18°, a projection range of -0.056 to 0.045 chord, and a Mach number range of 0.619 to 1.167. The plug-type spoiler-slot aileron was more effective in producing roll than the retractable spoiler aileron, particularly at the high angles of attack below the speed of sound.

NACA RM L52F24

CALIBRATION OF A COMBINED PITOT-STATIC TUBE AND VANE-TYPE FLOW ANGULARITY INDICATOR AT TRANSONIC SPEEDS AND AT LARGE ANGLES OF ATTACK OR YAW. Albin O. Pearson and Harold A. Brown. September 1952. 25p. diagrs., photos. (NACA RM L52F24) (Declassified from Confidential, 10/12/54)

The calibration of a combination pitot-static tube and vane-type flow-angularity indicator is presented for a Mach number range of approximately 0.60 to 1.11, an angle-of-attack range of -10° to 25°, and an angle-of-yaw range of -20° to 20°.

NACA RM L52G03

THE EFFECT OF VARIOUS AERODYNAMIC BALANCES ON THE LOW-SPEED LATERAL-CONTROL AND HINGE-MOMENT CHARACTERISTICS OF A 0.20-CHORD PARTIAL-SPAN OUTBOARD AILERON ON A WING WITH LEADING EDGE SWEPT BACK 51.3°. Alexander D. Hammond. September 1952. 40 p. diagrs., photo., tab. (NACA RM L52G03) (Declassified from Confidential, 10/12/54)

A wind-tunnel investigation at low speeds was made to determine the lateral-control and hinge-moment characteristics of an unsealed, plain-radius-nose, 20-percent-chord, flat-sided, partial-span outboard aileron equipped with either an overhang, a paddle, or a spoiler balance on a wing with leading edge swept back 51.3°, aspect ratio of 3.05, taper ratio of 0.49, and NACA 65_1-012 airfoil sections perpendicular to the 55.6-percent chord line.

NACA RM L52G08

HINGE-MOMENT AND CONTROL-EFFECTIVENESS CHARACTERISTICS OF AN OUTBOARD FLAP WITH AN OVERHANG NOSE BALANCE ON A TAPERED 35° SWEPTBACK WING OF ASPECT RATIO 4. TRANSONIC-BUMP METHOD. Robert F. Thompson and William C. Moseley, Jr. August 1952. 51p. diagrs. (NACA RM L52G08) (Declassified from Confidential, 10/12/54)

Lift, pitching-moment, rolling-moment, and flap hinge-moment coefficients were obtained through the transonic speed range on a wing having a quarter-chord sweepback of 35°, an aspect ratio 4, a taper ratio of 0.6, and an NACA 65A006 airfoil section parallel to free stream. The wing had a 30-percent-chord 0.43-span outboard flap-type control with a 22-percent-flap-chord overhang nose balance. The investigation was made through an angle-of-attack range of -6° to 16°, a Mach number range from 0.6 to 1.10, and a range of flap deflections which varied from about ±24° at a Mach number of 0.60 to ±12° at a Mach number of 1.10.

NACA RM L52G10

LOW-SPEED LATERAL-CONTROL INVESTIGATION OF A FLAP-TYPE SPOILER AILERON WITH AND WITHOUT A DEFLECTOR AND SLOT ON A 6-PERCENT-THICK, TAPERED, 45° SWEPTBACK WING OF ASPECT RATIO 4. James M. Watson. September 1952. 11p. diagrs. (NACA RM L52G10) (Declassified from Confidential, 10/12/54)

Results are presented of an investigation to determine the lateral-control characteristics of a deflector and slot arrangement in conjunction with a flap-type spoiler aileron on a 6-percent-thick wing with 45° sweepback of the quarter-chord line, an aspect ratio of 4, and a taper ratio of 0.6. Data were obtained through a range of angle of attack from -26° to 60°, projections of 0 and 0.05 chord for both the flap-type spoiler aileron and the deflector. The spoiler-deflector-slot combination was more effective than the spoiler alone in producing rolling moment.

NACA RM L52G16

TESTS OF A CENTERING SPRING USED AS AN ARTIFICAL FEEL DEVICE ON THE ELEVATOR OF A FIGHTER AIRPLANE. James J. Adams and James B. Whitten. September 1952. 18p. diagrs., photo., tab. (NACA RM L52G16) (Declassified from Confidential, 10/12/54)

Tests were made of a centering spring, which gave no variation of force gradient with impact pressure used as an artificial feel device for the elevator of a Chance Vought F4U-4B airplane equipped with power controls. The centering spring was unsatisfactory because of the large stick force encountered in landing. When a preloaded spring was included in the system to relieve the large landing force, and a bobweight was added to increase the force per g, the system satisfied the minimum handling-qualities requirements, but was still considered to provide insufficient centering tendency at high speeds.

NACA RM L52G22

THE EFFECTS OF CAMBER AND LEADING-EDGE-FLAP DEFLECTION ON THE PRESSURE PULSATIONS ON THIN RIGID AIRFOILS AT TRANSONIC SPEEDS. Milton D. Humphreys and John D. Kent. October 1952. 26p. diagrs., photos., tab. (NACA RM L52G22) (Declassified from Confidential, 10/12/54)

The effect of camber and leading-edge-flap deflection on the pressure pulsations on thin rigid airfoils at Mach numbers from 0.5 to 1.0 has been investigated for 6-percent-thick NACA 64A-series airfoils. The results of the pressure-pulsation investigation on these airfoils indicated that at the higher normal-force coefficients, either camber or leading-edge-flap deflection reduced the pressure-pulsation level over the entire chord.

NACA RM L52G24

EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF VORTEX GENERATORS ON THE MAXIMUM LIFT OF A 6-PERCENT-THICK SYMMETRICAL CIRCULAR-ARC AIRFOIL SECTION. William J. Bursnall. October 1952. 16p. diagrs., 2 tabs. (NACA RM L52G24) (Declassified from Confidential, 10/12/54)

The results of an experimental investigation of the effectiveness of several configurations of vortex generators in increasing the maximum lift of a 6-percent-thick symmetrical circular-arc airfoil section indicated that none of the configurations employed substantially increased the maximum lift.

NACA RM L52G25

A PRELIMINARY INVESTIGATION OF SHOCK-WAVE REFLECTIONS IN A SMALL CLOSED BALLISTIC RANGE WITH VARIOUS TYPES OF WALLS. A. P. Sabol. September 1952. 21p. photos., diagrs. (NACA RM L52G25) (Declassified from Confidential, 10/12/54)

The intensity of reflections from walls of shock waves, which were created by a bullet traveling near the speed of sound, was observed by shadow and schlieren methods. Results indicated that reflected waves are greatly reduced by the use of a wall material having good sound-absorbing characteristics, or by specially designed wall configurations.

NACA RM L52G31a

EFFECT OF THICKNESS, CAMBER, AND THICKNESS DISTRIBUTION ON AIRFOIL CHARACTERISTICS AT MACH NUMBERS UP TO 1.0. Bernard N. Daley and Richard S. Dick. October 1952. 76p. photos., diagrs., tab. (NACA RM L52G31a) (Declassified from Confidential, 10/12/54)

A modified open-throat-type wind tunnel developed for the purpose of obtaining two-dimensional-airfoil data at Mach numbers near 1.0 is presented and discussed. Tests of a group of related NACA airfoil sections varying in maximum thickness, design lift coefficient, and thickness distribution have been conducted in this wind tunnel at Mach numbers of 0.3 to about 1.0, and at corresponding Reynolds numbers from 0.7×10^6 to 1.6×10^6. Normal-force, drag, and moment coefficients are presented, together with representative schlieren photographs and pressure-distribution diagrams.

NACA RM L52H04

HEAT TRANSFER AND SKIN FRICTION FOR TURBULENT BOUNDARY LAYERS ON HEATED OR COOLED SURFACES AT HIGH SPEEDS. Coleman duP. Donaldson. October 1952. 20p. diagr., 3 tabs. (NACA RM L52H04) (Declassified from Confidential, 10/12/54)

The method presented in NACA TN 2692 for evaluating the skin friction of a turbulent boundary layer in compressible flow on an insulated surface is extended to evaluate the turbulent skin friction and heat transfer in compressible flow on a surface which is heated or cooled. The results of this analysis are in good agreement with the heat transfers measured in flight on the NACA RM-10 missile up to Mach number of 3.8.

NACA RM L52H07

INVESTIGATION OF THREE TAPERED 45° SWEPTBACK CAMBERED AND TWISTED WINGS COVERING A SIMULTANEOUS VARIATION IN ASPECT RATIO AND THICKNESS RATIO AND OF ONE RELATED SYMMETRICAL WING AT TRANSONIC SPEEDS BY THE WING-FLOW METHOD. Harold I. Johnson. March 1953. 55p. diagrs., photos., 2 tabs. (NACA RM L52H07) (Declassified from Confidential, 10/12/54)

An investigation at transonic speeds was made to study the effects of aspect ratio of a 45° sweptback wing for the case where thickness ratio is varied in a logical manner with aspect ratio. The effects of camber and twist were also investigated. The Mach numbers ranged from 0.65 to 1.17 and the Reynolds numbers ranged from 230,000 to 620,000. Results showed that the lowest-aspect-ratio, thinnest wing tested had the best aerodynamic characteristics in

all important respects. The addition of camber and twist reduced the maximum lift-drag ratios over most of the speed range tested but increased the maximum lift coefficient at all speed.

NACA RM L52H11

A STUDY OF THE FLOW FIELD BEHIND THE TRIANGULAR HORIZONTAL TAIL OF A CANARD AIRPLANE AT APPROXIMATELY THE VERTICAL-TAIL LOCATION BY MEANS OF A TUFT GRID. Joseph L. Johnson, Jr. October 1952. 18p. diagrs., tab. (NACA RM L52H11) (Declassified from Confidential, 10/12/54)

An investigation of the flow field behind the horizontal triangular tail of a canard model by means of a tuft grid placed at approximately the vertical-tail location (about 6.0 horizontal-tail root chords behind the horizontal tail) indicated that trailing vortices from the horizontal tail produced a sidewash field over the model which probably accounted for the variation in the static directional stability and damping-in-yaw characteristics of canard models reported in previous investigations.

NACA RM L52H20

A TRANSONIC INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF PLATE- AND BELL-TYPE OUTLETS FOR AUXILIARY AIR. William J. Nelson and Paul E. Dewey. September 1952. 25p. diagrs., photos. (NACA RM L52H20) (Declassified from Confidential, 10/12/54)

The aerodynamic characteristics of several plate-type and bell-mouthed outlets representative of current design practice have been investigated at Mach numbers from 0.7 to 1.3. These data show that the effect of an external stream on the discharge coefficient of such outlets is determined primarily by the rate of discharge relative to the free-jet flow rate. For outlets of the types tested, low-speed data may probably be applied at transonic Mach numbers if the free-jet characteristics of the outlet are first corrected for the effects of Reynolds number and Mach number on the discharge characteristics of the outlet discharging into infinite space. Total-pressure surveys through the jet wake are compared at Mach numbers of 0.7, 1.1, and 1.3 for the different outlets investigated. Static-pressure distribution in the vicinity of circular outlets is shown for several Mach numbers and discharge rates.

NACA RM L52H21

INVESTIGATION OF THE VARIATION WITH REYNOLDS NUMBER OF THE BASE, WAVE, AND SKIN-FRICTION DRAG OF A PARABOLIC BODY OF REVOLUTION (NACA RM-10) AT MACH NUMBERS OF 1.62, 1.93, AND 2.41 IN THE LANGLEY 9-INCH SUPERSONIC TUNNEL. Eugene S. Love, Donald E. Coletti and August F. Bromm, Jr. October 1952. 62p. diagrs., photos., (NACA RM L52H21) (Declassified from Confidential, 10/12/54)

Results are presented from an investigation at M = 1.62, 1.93, and 2.41 of the variation with Reynolds number of the base, wave, and skin-friction drag of a parabolic body of revolution (NACA RM-10). Comparisons are made with theory and other experimental data. An empirical expression relating the Reynolds number of transition to Mach number is presented as well as an explanation of the behavior of base pressure with varying Reynolds number.

NACA RM L52I02

INVESTIGATION AT HIGH AND LOW SUBSONIC MACH NUMBERS OF TWO SYMMETRICAL 6-PERCENT-THICK AIRFOIL SECTIONS DESIGNED TO HAVE HIGH MAXIMUM LIFT COEFFICIENTS AT LOW SPEEDS. Nicholas J. Paradiso. October 1952. 37p. diagrs., photo., 2 tabs. (NACA RM L52I02) (Declassified from Confidential, 10/12/54)

Results are presented of an investigation at both high and low subsonic Mach numbers of two newly derived symmetrical 6-percent-thick airfoil sections which are of a family of airfoil sections designed for high maximum lift at low subsonic speeds. As compared to previously tested sections of this family, the sections of this investigation have less blunt leading edges. Included are results for Reynolds numbers up to 9×10^6 and for two locations of surface roughness.

NACA RM L52I03

THRUST LOADING OF THE NACA 3-(3)(05)-05 EIGHT-BLADE DUAL-ROTATING PROPELLER AS DETERMINED FROM WAKE SURVEYS. Robert J. Platt, Jr. October 1952. 44p. diagrs., photo. (NACA RM L52I03) (Declassified from Confidential, 10/12/54)

Wake-survey measurements of the thrust loading of the NACA 3-(3)(05)-05 eight-blade dual-rotating propeller are presented to supplement the previously published force-test results for this propeller. The data cover a blade-angle range from 65° to 80°, measured at 0.75R, at forward Mach numbers from 0.35 to 0.925.

NACA RM L52I08

FORCE TESTS OF THREE THIN WINGS OF MODERATELY LOW ASPECT RATIO AT HIGH SUBSONIC MACH NUMBERS. Gareth H. Jordan. October 1952. 22p. diagrs. (NACA RM L52I08) (Declassified from Confidential, 10/12/54)

Results are presented of force tests made in the Langley 24-inch high-speed tunnel on three thin wings of moderately low aspect ratio at high subsonic Mach numbers to determine the effect of leading-edge shape and section profile on the aerodynamic characteristics. The range of angle of attack was from -2° to 8° and the range of Mach number was from 0.30 to about 0.90.

NACA RM L52I09

ANALYTICAL STUDY OF STATIC AND LOW-SPEED PERFORMANCE OF THIN PROPELLERS USING TWO-SPEED GEAR RATIOS TO OBTAIN OPTIMUM ROTATIONAL SPEEDS. Jean Gilman, Jr. November 1952. 52p. diagrs., 4 tabs. (NACA RM L52I09) (Declassified from Confidential, 10/12/54)

This paper presents methods of estimating the static and low-speed performance of thin propellers when operating at optimum rotational speeds. The importance, under certain conditions, of incorporating variable gearing is illustrated by specific examples. The effect of camber on static thrust is also investigated, and it is shown that thin propellers having moderately cambered blade sections can produce 15 to 20 percent more static thrust than propellers having symmetrical blade sections.

NACA RM L52K18a

A STUDY OF THE USE OF VARIOUS HIGH-LIFT DEVICES ON THE HORIZONTAL TAIL OF A CANARD AIRPLANE MODEL AS A MEANS OF INCREASING THE ALLOWABLE CENTER-OF-GRAVITY TRAVEL. Joseph L. Johnson, Jr. January 1953. 25p. diagrs., 2 tabs. (NACA RM L52K18a) (Declassified from Confidential, 10/12/54)

This paper contains results of a low-speed power-off static longitudinal stability and control investigation to study the use of various high-lift devices on the horizontal tail of a canard airplane model as a means of increasing the allowable center-of-gravity travel.

NACA RM L52K28a

AVERAGE SKIN-FRICTION COEFFICIENTS FROM BOUNDARY-LAYER MEASUREMENTS ON A OGIVE-CYLINDER BODY IN FLIGHT AT SUPERSONIC SPEEDS. J. Dan Loposer. January 1953. 11p. diagrs., photo. (NACA RM L52K28a) (Declassified from Confidential, 10/12/54)

Boundary-layer measurements on a rocket-powered free-flight model to determine average skin-friction coefficients have been made on an ogive-cylinder body of fineness ratio 15.9. Average skin-friction coefficients were obtained for the body area ahead of the fins over a range of Mach number from 1.3 to 2.5 and over a range of Reynolds number from 90.3×10^6 to 162.9×10^6 (based on axial body length to the measurement station). Comparison of the experimental data with a flat-plate skin-friction theory by Van Driest showed good agreement.

NACA RM L52L02

A COMPARISON OF GUST LOADS MEASURED IN FLIGHT ON A SWEPT-WING AIRPLANE AND AN UNSWEPT-WING AIRPLANE. Jack Funk and Harry C. Mickleboro. June 1953. 16p. diagrs., 2 tabs. (NACA RM L52L02) (Declassified from Confidential, 10/12/54)

An unswept-wing airplane and a 35° swept-wing airplane were flown in rough air to investigate effects of sweep on gust loads and gust selectivity. The swept-wing airplane experienced lower loads in rough air than the unswept-wing airplane. The ratio of loads on the two airplanes was equal to the cosine of the angle of sweep and to the ratio of the lift-curve slopes from either low-speed wind-tunnel data or calculated from the empirical formula $\frac{6A \cos \Lambda}{A + 2 \cos^2 \Lambda}$, where A is aspect ratio and Λ is the angle of sweep. Only small differences were shown in the gust selectivity characteristics of the two airplanes.

NACA RM L52L09

WING AND FUSELAGE LOADS MEASURED IN FLIGHT ON THE NORTH AMERICAN B-45 AND F-82 AIRPLANES. Paul W. Harper. February 1953. 35p. diagrs., 4 tabs. (NACA RM L52L09) (Declassified from Confidential, 10/12/54)

Flight investigations were conducted to determine the wing and fuselage loads on the B-45 and F-82 airplanes by means of calibrated strain-gage installations at each wing- and tail-fuselage juncture. The tests covered a Mach number range of approximately 0.3 to 0.75. The aerodynamic loads measured for the B-45 airplane were substantially as predicted by theory, but the loads on the F-82 airplane were in disagreement with theory. A gradual outboard shift in wing center of pressure with increasing Mach number was noted for both airplanes.

NACA RM L52L11

EXPERIMENTAL INVESTIGATION OF THE FLOW FIELD BEHIND AN ASPECT-RATIO-10 HYDROFOIL NEAR THE WATER SURFACE. Arthur W. Carter and Roger V. Butler. February 1953. 31p. diagrs., photos., tab. (NACA RM L52L11) (Declassified from Confidential, 10/12/54)

An investigation was made at subcritical speeds of the flow field behind an aspect-ratio-10 hydrofoil operating at a depth below the free-water surface of 0.75 chord. The downwash and water surface profiles were measured behind the hydrofoil over a range of lateral and longitudinal positions of interest for tandem hydrofoil applications. The experimental data were compared with theoretical predictions based on two-dimensional flow.

NACA RM L52L22

FREE-FLIGHT-TUNNEL INVESTIGATION OF THE LOW-SPEED STABILITY AND CONTROL CHARACTERISTICS OF A MODEL HAVING A FUSELAGE OR RELATIVELY FLAT CROSS SECTION. John W. Paulson and Joseph L. Johnson, Jr. February 1953. 30p. diagrs., photo., tab. (NACA RM L52L22) (Declassified from Confidential, 10/12/54)

Results are presented of an experimental investigation in the Langley free-flight tunnel to determine the dynamic lateral stability and control characteristics of a model having a relatively flat cross-section fuselage. Tests were made with several vertical-tail configurations and with the leading-edge flap retracted and extended.

NACA RM L52L26a

EFFECTS OF ROUGHNESS AND REYNOLDS NUMBER ON THE NONLINEAR LIFT CHARACTERISTICS OF A WING WITH MODIFIED HEXAGONAL AIRFOIL SECTIONS. Milton A. Schwartzberg. February 1953. 18p. diagrs., photo. (NACA RM L52L26a) (Declassified from Confidential, 10/12/54)

Nonlinear lift characteristics of a low-aspect-ratio wing with modified hexagonal airfoil sections at low Reynolds numbers were observed at Mach numbers from 0.379 to 0.896. Effects of increased Reynolds numbers and of surface roughness on the linearity of the lift curves were investigated.

NACA RM L53A19

SOME TORSIONAL-DAMPING MEASUREMENTS OF LAMINATED BEAMS AS APPLIED TO THE PROPELLER STALL-FLUTTER PROBLEM. Atwood R. Heath, Jr. April 1953. 14p. diagrs., photos., tab. (NACA RM L53A19) (Declassified from Confidential, 10/12/54)

The structural damping in the torsion mode of vibration of a series of untwisted, laminated thin beams simulating propeller blades is presented. The number of laminations were varied, as well as the bonding material and the method of joining laminations. Application of the data to the calculation of the minimum flutter speed of thin propeller blades indicates that appreciable gains in the minimum flutter speed may be obtained for laminated blades using a Cycleweld bond.

NACA RM L53B19

WIND-TUNNEL INVESTIGATION OF THE EFFECTS OF VARIOUS DORSAL-FIN AND VERTICAL-TAIL CONFIGURATIONS ON THE DIRECTIONAL STABILITY OF A STREAMLINED BODY OF TRANSONIC SPEEDS. TRANSONIC-BUMP METHOD. Harold S. Johnson and William C. Hayes. April 1953. 22p. diagrs., photo., tab. (NACA RM L53B19) (Declassified from Confidential, 10/12/54)

Yawing-moment coefficients were obtained for several dorsal-fin and vertical-tail configurations in combination with a streamlined body through a large angle-of-sideslip range and a Mach number range of 0.59 to 1.11. The results indicated that dorsal fins improved the directional stability characteristics of the body alone and the body—vertical-tail configuration. A ring tail was more effective at small angles of sideslip and less effective at large angles of sideslip than a tapered low-aspect-ratio vertical tail.

NACA RM L53C10

A PRELIMINARY INVESTIGATION OF AERODYNAMIC CHARACTERISTICS OF SMALL INCLINED AIR OUTLETS AT TRANSONIC MACH NUMBERS. Paul E. Dewey. April 1953. 21p. photos., diagrs. (NACA RM L53C10) (Declassified from Confidential, 10/12/54)

The aerodynamic characteristics of several outlets with inclined or curved axes discharging air into a transonic stream have been investigated. The data presented herein show the discharge coefficient of such outlets and static-pressure distribution in the vicinity of the outlets for several values of stream Mach number and discharge flow parameter. Tuft observations, showing the vortex formation caused by the outlet discharge from a perpendicular and an inclined outlet, are also presented.

NACA RM L53D21

MEASUREMENTS OF AERODYNAMIC CHARACTERISTICS AT TRANSONIC SPEEDS OF AN UNSWEPT AND UNTAPERED NACA 65-009 AIRFOIL MODEL OF ASPECT RATIO 3 WITH 1/4-CHORD PLAIN FLAP BY THE NACA WING-FLOW METHOD. Harold I. Johnson. June 1953. 35p. diagrs., photo. (NACA RM L53D21) (Declassified from Confidential, (10/12/54)

Lift, pitching-moment, and hinge-moment data obtained from wing-flow tests of an unswept, untapered NACA 65-009 airfoil model of aspect ratio 3.01 equipped with 1/4-chord full-span plain flap are presented. Effects of flap gap and of roughness were investigated. The Mach number range of the tests was 0.65 to 1.10 and the Reynolds number range was 0.5×10^6 to 0.9×10^6.

NACA RM L53D30

CALCULATION OF AERODYNAMIC FORCES ON AN INCLINED DUAL-ROTATING PROPELLER. John L. Crigler and Jean Gilman, Jr. June 1953. 24p. diagrs. (NACA RM L53D30) (Declassified from Confidential, 10/12/54)

This paper presents a method of calculating the fluctuating aerodynamic forces on a dual-rotating propeller the thrust axis of which is inclined at an angle to the air stream. Sample calculations are made and the results are analyzed to show some of the effects encountered with this type of operation.

NACA RM L53E12

EFFECTS OF COMPRESSIBILITY AT MACH NUMBERS UP TO 0.8 ON INTERNAL-FLOW CHARACTERISTICS OF A COWLING-SPINNER COMBINATION EQUIPPED WITH AN EIGHT-BLADE DUAL-ROTATION PROPELLER. Gene J. Bingham and Arvid L. Keith, Jr. June 1953. 39p. diagrs., photos. (NACA RM L53E12) (Declassified from Confidential, 10/12/54)

An investigation has been conducted to study the effects of compressibility for Mach numbers up to 0.8 on the internal-flow characteristics of an NACA 1-series cowling-spinner combination equipped with a dual-rotation propeller. Two propellers having 24-percent-thick shank sections were studied; one had the propeller shanks extended to the spinner surface and the juncture sealed, and the other had a raised platform-type juncture with the gap required to allow blade-angle changes located outside of the spinner boundary layer. The effects of variations in inlet height and rate of internal compression on the internal-flow characteristics were also studied. Total- and static-pressure distributions and average impact pressure coefficients measured at the inlet and at a diffuser station are presented.

NACA RM L53E28a

INVESTIGATION AT TRANSONIC SPEEDS OF THE HINGE-MOMENT AND LIFT-EFFECTIVENESS CHARACTERISTICS OF A SINGLE FLAP AND A TANDEM FLAP ON A 60° DELTA WING. Delwin R. Croom and Harleth G. Wiley. July 1953. 16p. diagrs. (NACA RM L53E28a) (Declassified from Confidential, 10/12/54)

This paper presents the results of an investigation to determine the comparative hinge-moment and lift-effectiveness characteristics of a single flap and a tandem flap on a semispan 60° delta-wing model at transonic speeds by the transonic-bump method. The delta-wing model was a flat plate with beveled leading and trailing edges, a maximum thickness ratio of 0.045, 60° sweepback at the leading edge, a taper ratio of 0, and an aspect ratio of 2.31. Lift and hinge moments were obtained through a Mach number range of 0.60 to 1.11. The tandem flap had less variation of C_{h_δ} (hinge-moment coefficient per degree flap deflection) with Mach number than did the single flap and the lift effectiveness was only about 50 percent of that obtained with the single flap.

NACA RM L53F16a

LOW-SPEED INVESTIGATION OF THE LATERAL CONTROL CHARACTERISTICS OF THREE TIP AILERONS ON A 60° TRIANGULAR WING. Stanley M. Gottlieb. August 1953. 24p. diagrs., photo. (NACA RM L53F16a) (Declassified from Confidential, 10/12/54)

An investigation has been made at a Reynolds number of 9 x 10^6 and a Mach number of 0.15 of the lateral control characteristics of three wing-tip ailerons on a 6-percent-thick, 60° triangular-wing-fuselage combination. The controls consisted of two half-delta ailerons having areas equal to 0.077 and 0.138 times the wing-semispan area and a full-delta aileron having an area equal to 0.138 times the wing-semispan area. The tests, which included measurements of rolling moments, hinge moments, yawing moments, and lateral force, were made through ranges of angle of attack and deflection from -12° to 38° and from -20° to 20°, respectively.

NACA RM L53G08

INVESTIGATION TO DETERMINE EFFECTS OF RECTANGULAR VORTEX GENERATORS ON THE STATIC-PRESSURE DROP THROUGH A 90° CIRCULAR ELBOW. E. Floyd Valentine and Martin R. Copp. September 1953. 35p. diagrs., photos. (NACA RM L53G08) (Declassified from Confidential, 10/12/54)

An investigation was made of a constant-area, circular 90° elbow of mean radius or curvature equal to its diameter with several arrangements of simple, nontwisted, rectangular vortex generators. They were installed at the inlet and also at stations 15°, 30°, and 60° into the elbow. The effect of the vortex generators on the pressure drop measured between the inlet and a station 4 diameters downstream of the elbow is given for one inlet-boundary-layer thickness.

NACA RM L53G23

TRANSONIC AERODYNAMIC CHARACTERISTICS OF AN NACA 64A006 AIRFOIL SECTION WITH A 15-PERCENT-CHORD LEADING-EDGE FLAP. Milton D. Humphreys. September 1953. 44p. diagrs., photos. (NACA RM L53G23) (Declassified from Confidential, 10/12/54)

Two-dimensional airfoil section normal-force, drag, pitching-moment, flap normal-force, and hinge-moment characteristics obtained on an NACA 64A006 airfoil section equipped with a 15-percent-chord leading-edge flap are presented for Mach numbers from 0.5 to 1.0. The leading-edge flap effected a general improvement in the force characteristics at Mach numbers up to 0.8 by alleviating flow separation at high normal-force coefficients.

NACA RM L53G23a

THE EFFECT OF CONTROL-SURFACE-SERVO NATURAL FREQUENCY ON THE DYNAMIC PERFORMANCE CHARACTERISTICS OF AN ACCELERATION CONTROL SYSTEM APPLIED TO A SUPERSONIC MISSILE. Anthony L. Passera and Martin L. Nason. September 1953. 28p. diagrs., 3 tabs. (NACA RM L53G23a) (Declassified from Confidential, 10/12/54)

A theoreotical investigation is made to determine the effect of the natural frequency of a second-order control-surface servo upon the dynamic performance characteristics of a normal-acceleration control system with respect to accuracy of control and accumulator volume of flow and peak rate of volume flow for several missile scale sizes and flight conditions in response to a step-input command. This paper seeks a compromise value of natural frequency that yields a control system with moderate volume flow and peak rate of volume flow along with good accuracy of control.

NACA RM L53H13

THE AERODYNAMIC CHARACTERISTICS AT TRANSONIC SPEEDS OF AN ALL-MOVABLE, TAPERED, 45° SWEPTBACK, ASPECT-RATIO-4 TAIL DEFLECTED ABOUT A SKEWED HINGE AXIS AND EQUIPPED WITH AN INSET UNBALANCING TAB. James M. Watson. September 1953. 40p. diagrs. (NACA RM L53H13) (Declassified from Confidential, 10/12/54)

This paper contains the results of an investigation at transonic speeds of an all-movable, aspect-ratio-4, taper-ratio-0.6 tail swept back 45° at the quarter-chord line, and deflected about a skewed hinge axis located behind the centers of pressure. The tail was equipped with an inset tab. Lift, pitching-moment, and hinge-moment data are presented for various tail angles of attack and deflections and tab deflections through a Mach number range of 0.61 to 1.21 obtained by the transonic-bump technique.

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